

## **DIVISION 3**

### **SECTION 03300 – CAST-IN-PLACE CONCRETE**

#### **PART 1 – GENERAL**

##### **1.01 Scope**

- A. Furnish all labor, materials, supplies and equipment and perform all operations including mixing, forming, reinforcing, placement, consolidation, curing, stripping, and finishing. Items of work include but are not limited to: drainage appurtenances, wall foundations and any other cast-in-place structural concrete.

##### **1.02 Work Not Included**

- A. Walks, curb and gutter, interior slabs, and other site paving.

##### **1.03 Related Work**

- A. Section 02200 – Earthwork and Grading.
- B. Section 02221 – Trenching, Backfilling and Compaction.
- C. Section 02750 – Portland Cement Concrete Paving.
- D. Section 02810 – Irrigation Installation.
- E. Section 02870 – Site Furnishings/Miscellaneous Facilities.
- F. Section 07900 – Joint Sealers

##### **1.04 Quality Assurance**

- A. Contractor Experience
  - 1. The work shall be done in a thorough, workmanship manner by contractors experienced in concrete construction.
  - 2. Contractor references for five similar, successfully executed projects will be required.
  - 3. The Contractor(s) guarantee their respective work against defective materials or faulty workmanship for a period of one year.
- B. City Standards: The requirements for curb, gutter, and sidewalk in the City of Fort Collins Design Criteria and Standards for Street (which for the remainder of this section shall be referred to a “City Standards”) will apply, except where specifically modified herein.
- C. Quality Control: Concrete Testing Service; Owner will engage a testing laboratory to perform materials evaluation, testing and design of concrete mixes. If test results meet the applicable specification, all testing costs will be borne by the Owner. Should any test(s) fail to meet the specifications, the cost of the failed test and all subsequent testing until the item meets specifications shall be borne by the Contractor.

The following sampling and testing shall occur during concrete placement, as follows:

- 1. Sampling: ASTM C172, “Specific Gravity and Absorption of Concrete Aggregate.” ASTM C31, “Making and Curing Concrete Test Specimens in the Field.”
- 2. Slump: ASTM C143, “Slump of Portland Cement Concrete,” one test for each set of compressive test specimens taken at point of discharge.
- 3. Air Content: ASTM C231, “Air Content of Freshly Mixed Concrete by the Pressure Method,” one for each set of compressive strength specimens.

4. Compressive Strength: ASTM C39, "Compressive Strength of Cylindrical Concrete Specimens."
  5. Report test results in writing to the Owner's Representative, Structural City Representative, Architect, Contractor, and Concrete Producer on same day tests are made.
- D. Mix Proportions and Design: City Standards shall be a minimum, unless more restrictive standards are listed.
- E. References:
1. ACI 301 – 89 - Structural Concrete for Buildings.
  2. ACI 318 – 89 – Building Code Requirements for Reinforced Concrete.

### **1.05 Submittals**

- A. Test Results: Perform and submit test reports for the following products in accordance with above general reference standards and specific requirements of these specifications.
- B. Proposed Mix Design:
1. The proportions of ingredients shall be selected to produce the proper placeability (slump), durability (air content), strength and other required properties of the section.
  2. Prior to commencing concrete work, submit and obtain Owner's approval of certified test reports describing proposed concrete mix design.
- C. Cylinder Compression Test Reports: Submit two copies of certified test reports to Owner.
- D. Shop Drawings for Reinforcement Bars:
1. Before fabrication of reinforcing steel, the Contractor shall review and approve shop drawings, bar lists, fabrication and setting drawings and shall submit same to Owner for review. Include 1/8-inch scale plan of all floors and walls with reinforcing indicated.
  2. Show sizes, quantity and dimensions for fabrication and placing of reinforcing bars and bar supports.

### **1.06 Test Panels**

Not applicable

### **1.07 Job Conditions**

- A. For hot or cold weather concreting refer to City Standards.

### **1.08 Guarantee/Replacement**

- A. The Contractor shall guarantee all concrete work for a period of **two (2) years** after acceptance against defective workmanship and materials. The determination of the necessity during such guarantee period for the Contractor to repair said curb, gutters, walks, driveways or crosspans, or any portion thereof, shall rest entirely with the Owner whose decision upon the matter shall be final and binding upon the Contractor.

## **PART 2 – MATERIALS**

### **2.01 Concrete**

- A. Cement: ASTM C150, Type II or Type I/II Portland Cement.
- B. Aggregates: ASTM C33, Specifications for Concrete Aggregates, maximum size not to exceed  $\frac{3}{4}$  inches.

- C. Water: Clean and not detrimental to concrete.
- D. Air-Entraining Admixture: ASTM C494, Type A.
- E. Water-Reducing Admixture: Refer to City Standards.
- F. Calcium Chloride: Use is prohibited.
- G. Related Materials:
  - 1. Construction Joints: Preformed metal keyway with removable plastic cap strip to be filled with joint sealer. John Screedkey or equal.
  - 2. Expansion Joint Fillers: ASTM D1752, ½ inch thick, nonextruding, preformed flexible closed-cell foam filler. Compression at 50%, 13.3 psi; extrusion 0.1 inch; recovery 99.21%; water absorption percent by volume 0.246%. Test method D545. Submit sample.
  - 3. Joint Sealing: See Section 07900.
  - 4. Curing Materials: Refer to City Standards.
- H. Form Materials: Refer to City Standards.
- I. Form Release Agent: Nonstaining agent that will not impair color or bonding characteristics of concrete.
- J. Chamfer Strips: ¾ inch, 45 ° job cutwood, or ¾ inch 45 ° PVC for unexposed surfaces. Use PVC for exposed surfaces.
- K. Reinforcing Materials:
  - 1. Reinforcing Steel: Deformed billet-steel, uncoated finish.
  - 2. Deformed Reinforcing Bars: ASTM A615, Grade 60 unless otherwise indicated. Use Grade 40 for ties and for dowels to be field bent.
  - 3. Dowels: ASTM A615, 40 ksi yield grade plain steel, uncoated finish.
  - 4. Tie Wire: No. 24 or No. 16 gauge, black, soft iron wire.
- L. Dovetail Anchors: Open triangular stainless steel type, 3/16 inch in diameter and 3 ½ inches long. Dur-O-Wall D/A 720 or equivalent, to consist of an anchor and a dovetail slot. The dovetail slot shall be cast into the concrete prior to installation of stone masonry.

**2.02 Concrete Production**

A. Proportioning:

1. Design and proportion concrete to meet the following minimum compressive strengths and other criteria:

<b>Location</b>	<b>Design Strength 28-Day</b>	<b>Required 7-Day Strength</b>	<b>Slump ± 1”</b>	<b>Minimum Cement Factor</b>	<b>Maximum Water-Cement Ratio by Weight</b>	<b>Air Entrainment</b>
<b>Structural Footings, Grade Beams, Foundations, Walls and all Other Concrete</b>	4,000	2,800	4	564	0.45	6% ± 1%

2. Other (e.g., drainage structures, manholes): Refer to individual specification sections.
3. For additional requirements, refer to City Standards.

**PART 3 – EXECUTION**

**3.01 Preparation**

- A. Ensure that subgrade elevation is correct as shown on the drawings, that the subgrade has been compacted to the specified density, and that the required density and moisture tests have been performed within 48 hours of starting concrete work.
- B. Where rough grading operations have over excavated, place, shape and compact bed course to the specified density.
- C. Allow a minimum of two hours for Owner’s Representative’s checkout before first concrete is placed.
- D. For further subgrade preparation requirements refer to City Standards.
- E. Cover masonry walls, glazing and other finish materials with polyethylene or other to protect from damage.

**3.02 Forming**

A. Formwork

1. Erect forms substantial and sufficiently tight to prevent leakage of mortar and boarded or tied to maintain the desired position, shape and alignment before, during and after concrete placement. The use of earth as a form will not be allowed.
2. Forms shall conform to shape, lines and dimensions indicated on the drawings.
3. Forms shall be reviewed by Owner’s Representative prior to concrete placement. Notify Owner three days prior to pouring.
4. Anchors, Inserts, Blockouts and Built-In-Items: Securely fasten built-in items to formwork, or hold in place with templates. Insertion into concrete after placement will not be permitted.
5. For additional formwork requirements, refer to City Standards.

B. Joints

1. Expansion Joints: Place where shown on the details and drawings.
2. Construction Joints: Place construction joints at all cold joints and as shown on the details and drawings. Submit to Architect for approval the locations of joints desired. Locate joints in walls and footings at least 8 feet from any corner. Leave joints in reinforced structural members rough and provide longitudinal keys at least 1 ½ inches deep.

C. Embedded Items

1. Place all sleeves, inserts, anchors and embedded items required for adjoining work or for its support prior to concreting. Coordinate with other construction trades before placing concrete.
2. Position expansion joint material, waterstops, anchor bolts, masonry anchors, castings, steel shapes, conduits, sleeves, and/or other embedded items accurately and support against displacement. Fill voids in sleeves, inserts and anchor slots temporarily with readily removable material to prevent the entry of concrete into the voids.
3. Install conduits between reinforcing steel in walls or slabs with reinforcing in both faces and below reinforcing in slabs with only one layer of reinforcing steel.
4. Embedments shall be clean when installed. Remove concrete spatter from all surfaces not in contact with concrete.
5. Provide dovetail slots for masonry anchors at a minimum of 18 inches on centers. Coordinate with project mason.

**3.03 Reinforcement**

- A. Comply with the specified codes and standards, CRSI “Manual of Standard Practice,” ACI 301 and CSI-WCRSI “Placing Reinforcing Steel.”
- B. No bars shall be field-bent, except as indicated on the drawings or specifically permitted by the Owner.
- C. Position, support and secure reinforcement against displacement. Locate and support with metal chairs, runners, bolsters, spacers and hangers as required. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces. Do not use pebbles, pieces of broken stone, common or face brick, metal pipe, or wood blocks to support reinforcement.
- D. Provide standard reinforcement splices by lapping ends, placing bars in contact and tightly tying wire. Comply with requirements of ACI 318 for minimum lap of spliced bars.
- E. Assure that excavation, formwork and reinforcement are completed and that dirt, mud, encrusted concrete, debris and ice, frost and excess water are removed.
- F. Check that reinforcement is secured in place as shown on the drawings.
- G. Verify that embedded items are secured in position.
- H. Verify that all required tests for pipes under slabs have been completed. Assure that all hardened concrete and foreign material is removed from the inner surface of conveying equipment.

**3.04 Placement of Concrete**

A. Conveying

1. Convey concrete from mixer to final position as rapidly as practicable without segregation or loss of material.
2. Use only metal or metal-lined chutes with maximum length of 20 feet, having a maximum slope of one vertical to two horizontal and a minimum slope of one vertical to three horizontal.

3. Provide a hopper at the end of long-belt conveyors and chutes not meeting the requirements in Paragraph 2 above.
4. Conveying by pumping methods shall conform to ACI 304, Chapter 9.
  - a. Maximum loss of slump, 2 inches.
  - b. Do not pump concrete having a slump of less than two inches.

B. Depositing

1. Place concrete in compliance with the practices and recommendations of ACI 304, "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete," and as herein specified.
2. Notify Owner not less than 8 working hours in advance of any pour and as soon as formwork and reinforcing are substantially complete. Notify Owner's testing service not less than 8 working hours in advance of any pour to schedule necessary testing.
3. No water shall be added to concrete at job site.
4. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section.
5. Maximum height of concrete free fall shall be 4 feet.
6. Perform concrete placing at such a rate that concrete which is being integrated with fresh concrete is still plastic. Deposit concrete as nearly as practicable to its final location to avoid segregation due to rehandling or flowing.
7. Do not subject concrete to any procedure that will cause segregation.
8. Protect concrete from physical damage or reduced strength due to weather extremes during mixing, placement and curing.
9. Allow concrete to thoroughly settle before top is finished. Remove all laitance, debris and surplus water from surfaces at tops of forms by screeding, scraping or other effective means.
10. Overfill forms wherever top of a wall will be exposed to weathering and after concrete has settled, screed off excess.
11. In cold weather comply with City of Fort Collins Specifications.
12. In hot weather comply with City of Fort Collins Specifications.

C. Consolidation

1. During and immediately after placement, thoroughly compact and work around all reinforcements, embedments and into corners of forms, eliminating all air or stone pockets which may cause honeycombing, pitting or planes of weakness, in accordance with the recommended practices of ACI 309 "Recommended Practice for Consolidation of Concrete."
2. Where vibration is necessary to achieve proper consolidation:
  - a. Use mechanical vibrators that will maintain at least 9,000 cycles per minute when immersed in concrete.
  - b. Minimum horsepower per vibrator shall be 1 ½.
  - c. Number and type of vibrators shall be acceptable to Owner.
  - d. Overvibrating and the use of vibrators to transport concrete laterally in forms will not be allowed.
  - e. Vertically insert vibrators at points approximately 18 inches apart and to a depth to penetrate 6 inches into the preceding layer.

- f. Vibrate each location for a length of time to obtain adequate consolidation (generally 5 to 15 seconds).

### **3.05 Concrete Finishes**

- A. Where work will be hidden from view, use rough form finish.
  1. Patch tie holes and defects.
  2. Remove fins greater than ¼ inch in height.
- B. Unless otherwise indicated, use formed surfaces or smooth form finishes where surfaces will be visible.
  1. Patch tie holes and defects.
  2. Completely remove fins.

### **3.06 Form Removal**

- A. Do not remove or disturb forms until the concrete has attained sufficient strength to safely support all dead and live loads. Use care in form removal to avoid surface gouging, corner or edge breakage and other damage to the concrete. Forms shall not be removed earlier than the following schedule:
  1. Walls and columns not yet supporting loads: 24 hours.

### **3.07 Curing**

- A. For curing requirements, refer to City Standards.

### **3.08 Repair of Defective Concrete**

- A. Repair to satisfaction of Owner, within 24 hours after removal of forms, all defects, including tie holes, in concrete surfaces.
- B. Replace to satisfaction of Owner, within 48 hours after adjacent forms have been removed, all honeycombed or otherwise defective concrete.
- C. Cut out and remove to sound concrete, with edges square cut to avoid feathering, all honeycombed or otherwise defective concrete.
- D. Replace flatwork that does not match appearance standards of Contractor's reference projects or sample panels
- E. Fill all holes with a non-shrink grout such as Master Builders Masterflo 713 or approved equal.

### **3.09 Quality Control**

- A. Concrete Tests: Coordinate and schedule testing with Owner's Representative
- B. Acceptance of Concrete
  1. If the average of three consecutive 7-day tests falls below the specified 7-day strength, the Owner shall have the right to require conditions of temperature and moisture necessary to secure the required strength and may require core tests in accordance with ASTM C-42.
  2. Strength level of concrete will be considered satisfactory so long as average of all sets of three consecutive strength test results equals or exceeds specified 28-day strength and no individual strength test result falls below specified strength by more than 500 psi.
- C. Failure of Test Cylinder Results

1. Upon failure of the 28-day test cylinder results, the Owner may require the Contractor, at his expense, to obtain and test at least three 2-inch diameter cored samples from area in question.
2. Concrete will be considered adequate if average of three core tests is at least 85 percent of, and if no single core is less than 75 percent of the specified 28-day strength.
3. Upon failure of core test results, the Owner may require the Contractor, at his expense, to perform load tests as specified in ACI 318, Chapter 2.
4. In the event an area is found to be structurally unsound, the Owner may order removal and replacement of concrete as required. The cost of the core tests, the load test and the structural evaluation shall be borne by the Contractor.
5. Fill all core holes with a non-shrink grout such as Master Builders Masterflo 713 or approved equal.

**END OF SECTION**